The Optimization of Desalination and Ion-Removal Rate Through the Engineering of Novel Turbulent Modular Designs in an Electrodialysis System

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According to the World Health Organization, 783-million people lack access to clean, drinking water. The majority of areas stricken with non-potable water, however, are relatively close in proximity to saline-water sources. Although reverse osmosis dominates the water-purification industry due to its cost effectiveness, the process recovers only 25 to 50% of feed solutions. The electrodialysis (ED) process, though, has been seen as a potential solution for recovering more water; however, current ED technologies are only cost effective below 3000 ppm. Thus, innovating the system or modular design of ED has been a lasting and present pursuit. The turbulent theory states that fluid eddies form through rapid changes in fluid velocity and pressure. Eddies augment the magnitude of hydrodynamic forces, causing the fluid to exert a greater force on a surface. The purpose of this study was to integrate three novel turbulent designs into an ED module in order to assess the effect of fluid turbulence on ion removal rate and total conductivity difference. Designs were modeled using CAD (Computer Aided Design) Onshape and were later 3D printed. The control was a conventional modular design for ED practices. The purified stream's ion content was measured using a Vernier conductivity sensor, and was graphed using Vernier Graphical Analysis software. Analysis confirmed statistical significance within the turbulent designs through facilitating greater ion removal and efficiency for briny water. These designs can be integrated into current ED processes as a cost effective alternative to increase ion removal efficiency within briny feed solutions.

Awards Won:

Second Award of $2,000